DATA SHEET

TEA6101/T
Antenna diversity circuit

Objective specification
File under Integrated circuits, IC01

May 1992

Philips Semiconductors

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FEATURES

- Ability to switch between up to four antennae
- Switching signal derived from two signals: the audio and the level signals
- Floating switching threshold adjusts switching rate to prevailing circumstances:
  - increasing threshold due to excessive noise
  - increasing threshold due to numerous level variations
- Memory for the most favourable antenna signal to overcome unnecessary switching
- Signal-dependent `soft` muting circuit
- Mode selection to the first antenna receiving an AM signal whilst the diversity system is reset.

APPLICATIONS

- Car radio receivers
- Mobile radio communications equipment

GENERAL DESCRIPTION

Intended for multi-antenna FM car radio reception (antenna diversity system), the TEA6101/T selects the most favourable signal from one of up to four antennae. Founded upon audible signal disturbance the criteria are derived from two signals: high frequency components (e.g. spikes due to noise and multipath reception) and variations in signal level as a result of multipath reception or fluctuations in field strength.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_P	positive supply voltage	–	8.5	–	V
I_P	positive supply current	–	14	–	mA
$V_{I(p-p)}$	audio input voltage (peak-to-peak value)	–	–	3	V
I_{os}	antenna switch output current (source/sink)	–	–	7	mA
V_L	–3 dB audio attenuation (soft mute)	–	1.45	–	V
T_{amb}	operating ambient temperature range	–30	–	+85	°C

ORDERING INFORMATION

EXTENDED TYPE NUMBER	PACKAGE			
	PINS	PIN POSITION	MATERIAL	CODE
TEA6101	18	DIL	plastic	SOT102(1)
TEA6101T	20	SO	plastic	SOT163A(2)

Notes

1. SOT102-1; 1996 September 10.
2. SOT163-1; 1996 September 10.

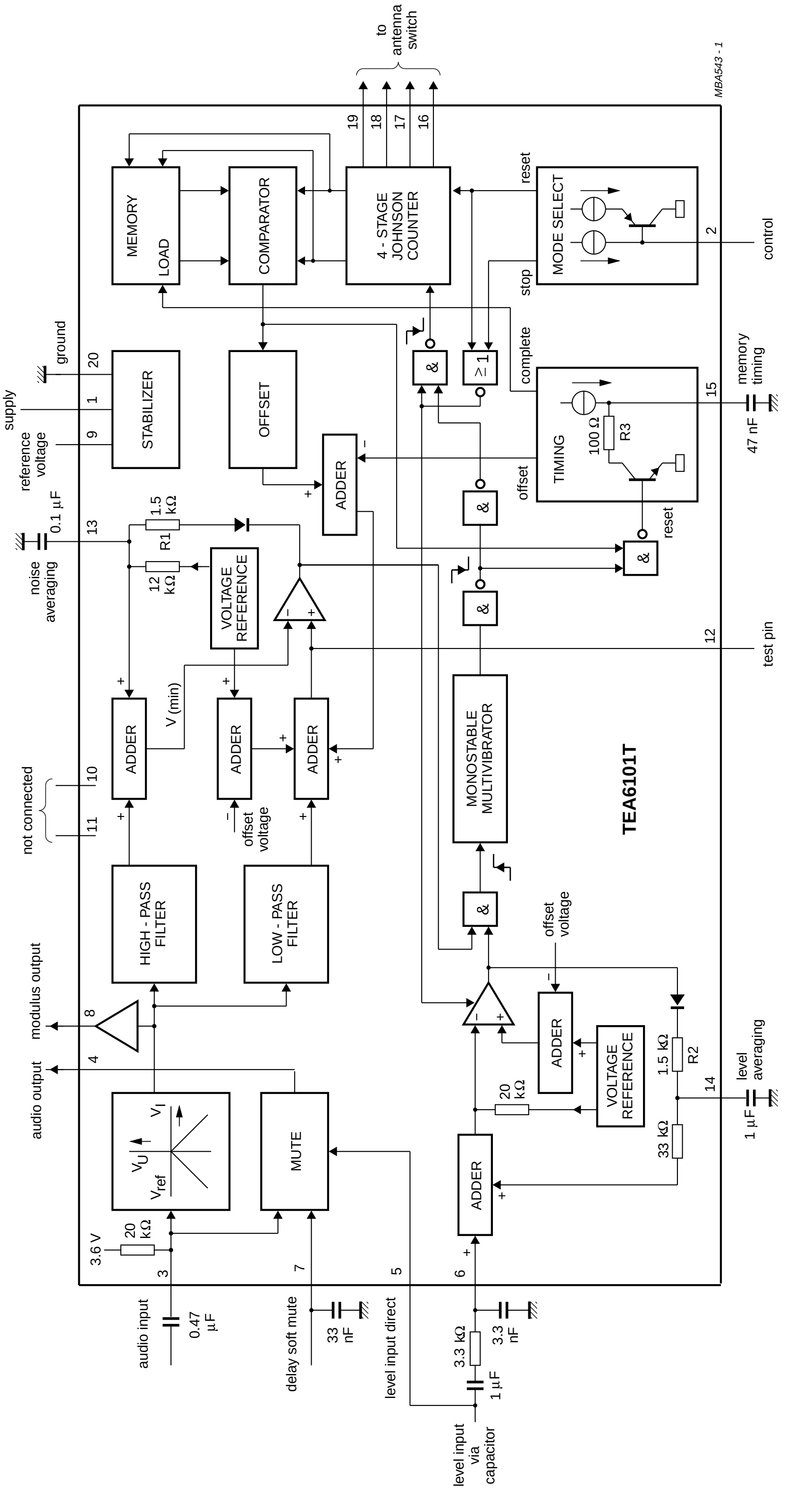


Fig.1 Block diagram.

PINNING

The pin numbers given in parenthesis refer to the TEA6101

SYMBOL	PIN		DESCRIPTION
V_P	1	(1)	positive supply
CTRL	2	(2)	control input
AUDIN	3	(3)	audio input
AUDOUT	4	(4)	audio output
LID	5	(5)	level input direct
LIC	6	(6)	level input via capacitor
DSM	7	(7)	delay soft mute
MODOUT	8	(8)	modulus output
V_{ref}	9	(9)	reference voltage
n.c.	10	–	not connected
n.c.	11	–	not connected
TEST	12	(10)	test pin
NOAV	13	(11)	noise averaging
LEAV	14	(12)	level averaging
MT	15	(13)	memory timing
OUT4	16	(14)	output 4
OUT3	17	(15)	output 3
OUT2	18	(16)	output 2
OUT1	19	(17)	output 1
GND	20	(18)	ground

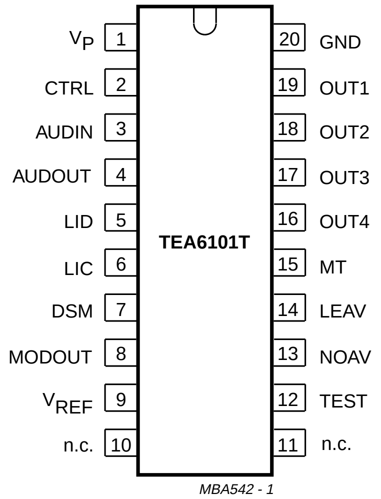


Fig.2 Pin configuration (TEA6101T).

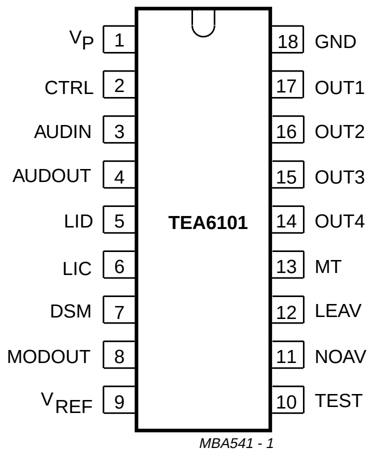


Fig.3 Pin configuration (TEA6101).

FUNCTIONAL DESCRIPTION

Various forms of disturbance can affect signal reception in car radio receivers:

- ignition interference produces spikes on the audio signal. Switching to another antenna will be ineffective. Strong ignition interference, however, will modulate the antenna field strength. In this instance another antenna possessing a directional pattern will suffer less disturbance and switching would be appropriate.
- variation of antenna field strength due to travelling through a zone of variable signal strength will result in a variation in the signal level. Greater noise will be apparent on the audio signal whilst the IF limiter is not limiting. Switching to an alternative antenna input would increase the signal strength.
- multipath reception occurs when a signal reaches the antenna from two or more directions. Often the signals will be of different phase. In certain circumstances the sum of the reflected signals results in zero and a large spike will be evident on the audio signal. It will then be necessary to switch to an alternative antenna from which the sum of the received signals will be different.

The criteria for an antenna diversity system are high frequency components (spikes and noise) on the audio signal in combination with variations in signal level.

Detection of spikes on the audio signal

A rectifier, high pass filter, low pass filter and a comparator are used to detect spikes and noise on the audio signal (see Fig.1). The negative spikes are detected by the rectifier whilst a high pass filter removes the audio signal to leave the high frequency signal components at the negative input to the comparator. The signal at the positive input to the comparator consists of an offset together with an audio signal attenuated by the low pass filter. If the amplitude of the spikes exceed that of the attenuated audio plus offset, the output of the comparator is HIGH.

When the switching rate of the comparator is HIGH, feedback increases the offset via the diode, the resistor R1, and the 100 nF capacitor. The offset is decreased by the 12 kΩ resistor and the 100 nF capacitor (pin 11 or 13). The result is an offset based upon the comparator switching rate, rapid to increase but slow to decrease, therefore permitting only the largest spikes to trigger the comparator (floating threshold).

Should high noise be apparent on the audio signal, the offset is decreased by means of the rectifier and high pass filter.

This will result in more frequent switching to an alternative antenna whilst the result of the switching operation will be less audible.

Detection of voltage level variation

A 1 µF input capacitor and 20 kΩ resistor remove the absolute level voltage to leave only variations to be detected. The level comparator output is HIGH when the variations in level voltage are greater than the offset. Similarly to the audio comparator; the feedback diode, resistor R2, the 1 µF capacitor and the 33 kΩ resistor cause the threshold level to float. During periods of high activity the comparator thus switches only on the largest variations.

Switching to an alternative antenna

When both the level and the audio comparator outputs are HIGH, another output of the Johnson counter will be selected. Since switching to an alternative antenna would cause a disturbance of the audio and level signals the monostable multivibrator will prohibit the counter from selecting another antenna input for 21 µs.

Memory and timing

Approximately similar qualities of signal originating from different antennae could result in unnecessary antenna switching. This is prevented by appointing a priority antenna. The selection of an antenna without priority results in the audio offset being decreased by 1.2 V such that the audio comparator will have a HIGH output voltage. During the period of memory timing the offset increases towards the normal offset value. Should level alterations occur during this period another antenna will be selected. If, however, the memory is timed-out without the occurrence of signal variation, priority will be appointed to the selected antenna. Thus a priority antenna will be selected for the majority of the time during reception of almost all similarly weak antenna signals.

Mute

A mute function should not precede the circuit. This function is therefore assumed by the TEA6101. When used in combination with the TEA6100 the 20 kΩ input of the IF IC together with the 6 kΩ output resistor of the TEA6101 cause an attenuation of 3 dB. The mute circuit therefore has 3 dB amplification of level voltages in excess of 2.75 V.

Mode selection

The diversity system is intended for FM reception. To avoid an audible disturbance if it is used with an AM system, the circuit can be reset. In the reset mode antenna 1 (pin 17 (19)) is selected and both comparators are switched off to prevent pulses reaching the output.

For FM search tuning the diversity system may be similarly disabled. The selected antenna will again be retained with the comparators being inhibited.

Test pin

Although intended for test purposes the test pin can be used to increase the audio offset (resistor from pin 10 (12) to ground) or to change the compensation factor (resistor between pin 8 (8) and 10 (12)). These modifications permit the behaviour of the antenna switch to be adapted to alternative IF amplifier IC's.

LIMITING VALUES

In accordance with the absolute maximum system (IEC 134)

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_P	positive supply voltage	0	12	V
P_{tot}	total power dissipation	–	see Fig.3	
T_{amb}	operating ambient temperature range	–30	+85	°C
T_{stg}	storage temperature range	–55	+150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	THERMAL RESISTANCE
$R_{th\ c\text{-}a}$	from crystal to ambient (SOT102)	75 K/W
$R_{th\ c\text{-}a}$	from crystal to ambient (SOT163A)	150 K/W

DC CHARACTERISTICS

Measurements using application circuit (Fig 1) at T_{amb} = 25 °C and V_P = 8.5 V. Voltages with respect to pin 18 (20); pin numbers in parenthesis refer to TEA6101T; all currents positive into the IC unless otherwise specified.

SYMBOL	PARAMETER		CONDITION	MIN.	TYP.	MAX.	UNIT
V_P	positive supply voltage			7.5	8.5	12	V
I_P	positive supply current		I_{SO} = 0 mA	–	14	–	mA
P_{tot}	total power dissipation			–	119	–	mW
V_{pins}	voltage at pin:						
	1	(1)		–	8.5	–	V
	2	(2)		–	7.8	–	V
	3	(3)		–	3.6	–	V
	4	(4)		–	5.4	–	V
	5	(5)		–	0	–	V
	6	(6)		–	5.3	–	V
	7	(7)		–	0.6	–	V
	8	(8)		–	5.2	–	V
	9	(9)		–	5.4	–	V
	–	(10)		–	n.c.	–	
	–	(11)		–	n.c.	–	
	10	(12)		–	5.1	–	V
	11	(13)		–	5.4	–	V
	12	(14)		–	5.3	–	V
	13	(15)		–	0	–	V
	14	(16)		–	0	–	V
	15	(17)		–	0	–	V
	16	(18)		–	0	–	V
	17	(19)		–	7.5	–	V
	18	(20)		–	0	–	V

AC CHARACTERISTICS

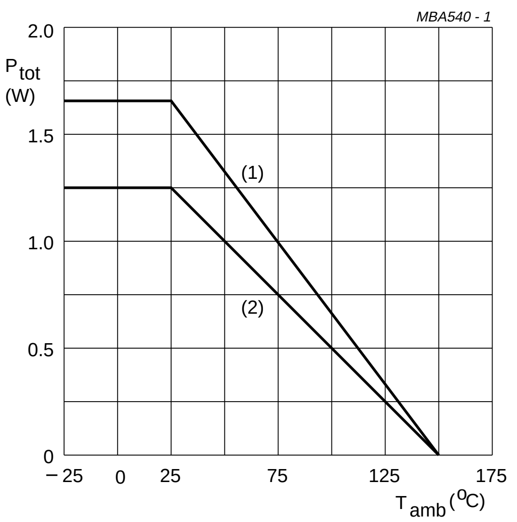
V_P = 8.5 V; T_{amb} = 25 °C; unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Mute						
SOFT MUTE (V_L)						
Z_I	input impedance (pin 3 (3))		–	20	–	kΩ
MR	mute range	note 1	17	19.3	–	V
V_{aud}/V_I	mute gain	V_L = 2.75 V V_L = 1.45 V	– –1	2.7 0.6	– 2	dB dB
HARD MUTE (V_{MUTE})						
V_{mute}	–60 dB output attenuation		–	455	–	mV
$+I_m$	mute ON sink current	V_{mute} = 1 V, V_L = 0 V	–	370	–	μA
$-I_m$	mute `OFF` source current	V_{mute} = 0 V	3	–	–	μA
THD	total harmonic distortion	V_i = 200 mV; V_L = 2.5 V	–	0.09	–	%
$V_{I(p-p)}$	audio input voltage (peak-to-peak value)	THD > 10%	–	3	–	V
(S+N)/N	signal-to-noise ratio; measured with dB(A) curve	V_{aud} = 600 mV; 1 kHz; V_L = 3 V	–	95	–	dB
V_{aud}/V_p	ripple rejection	note 2; 300 Hz; 100 mV; V_L = 2.5 V	28	32	–	dB
V_{ref}	output reference voltage		–	5.3	–	V
V_{off1}	audio comparator offset voltage	$V_{off1} = V_{min} - V_{ap}$ with priority with no priority V_t = 0 V V_t = 3 V	 – – –	 +250 –1100 –348	 – – –	 mV mV mV
Level comparator						
$V_{ref}–V_{il}$	voltage for high comparator output		–	56	–	mV
t	monostable multivibrator time period	started with both comparator outputs HIGH	16	21	28	μs
Timing/memory						
$-I_t$	source current		–	30	–	μA
C_t	value delay capacitor		–	–	50	nF
T_t	timing duration	C_t = 47 nF	–	6	–	ms
$+I_t$	reset current	V_t = 3 V	–	17.7	–	mA
V_t	change of priority antenna		–	3.7	–	V
Antenna switch outputs						
$-I_{os}$	output source current		–	–	7	mA
$+I_{os}$	output sink current		–	–	7	mA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{SO}	selected output voltage					
		I_{SO} = –10 mA	V_P–2 V	–	–	V
		I_{SO} = 0.5 mA	V_P–1 V	–	–	V
V_{NSO}	not selected output voltage					
		I_{SO} = +10 mA	–	–	0.7	V
		I_{SO} = 0 mA	–	–	0.1	V
Mode selection						
ENABLE						
V_r	all functions active		–	–	1	V
$–I_r$	input current	V_r = 1 V	–	–	12	μA
RESET (ACTIVE AT OPEN INPUT)						
V_r	voltage at first antenna (pin 17 (19))		4.2	–	V_P	V
STOP						
V_r	keep selected antenna voltage		1.6	–	3.5	V

Notes to the AC characteristics

1. $$\frac{V_{aud}\,(aV_L = 2.75V)}{V_{aud}\,(aV_L = 0.1V)}$$
2. When V_P (pin 1 (1)) is filtered with R = 25 Ω and C = 100 μF the ripple rejection becomes 46 dB

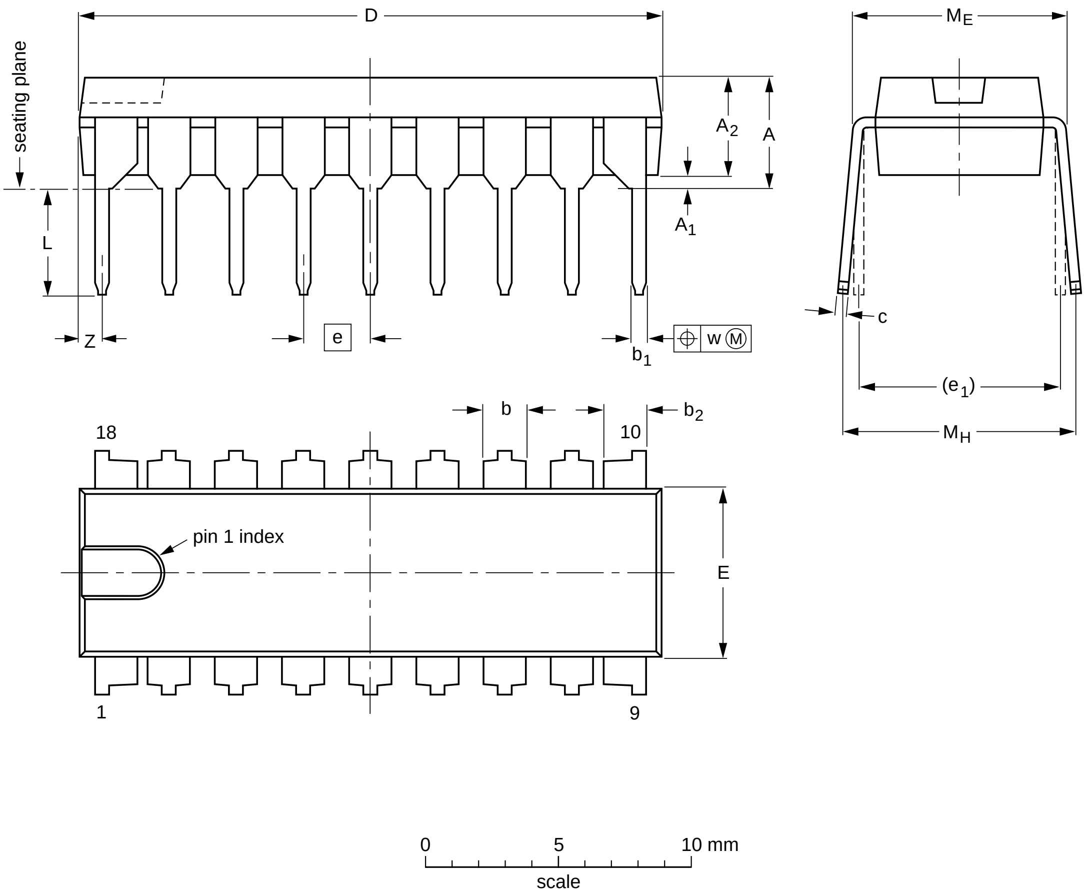


(1) SOT102
(2) SOT163A

Fig.4 Derating curve.

PACKAGE OUTLINES

DIP18: plastic dual in-line package; 18 leads (300 mil) | SOT102-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

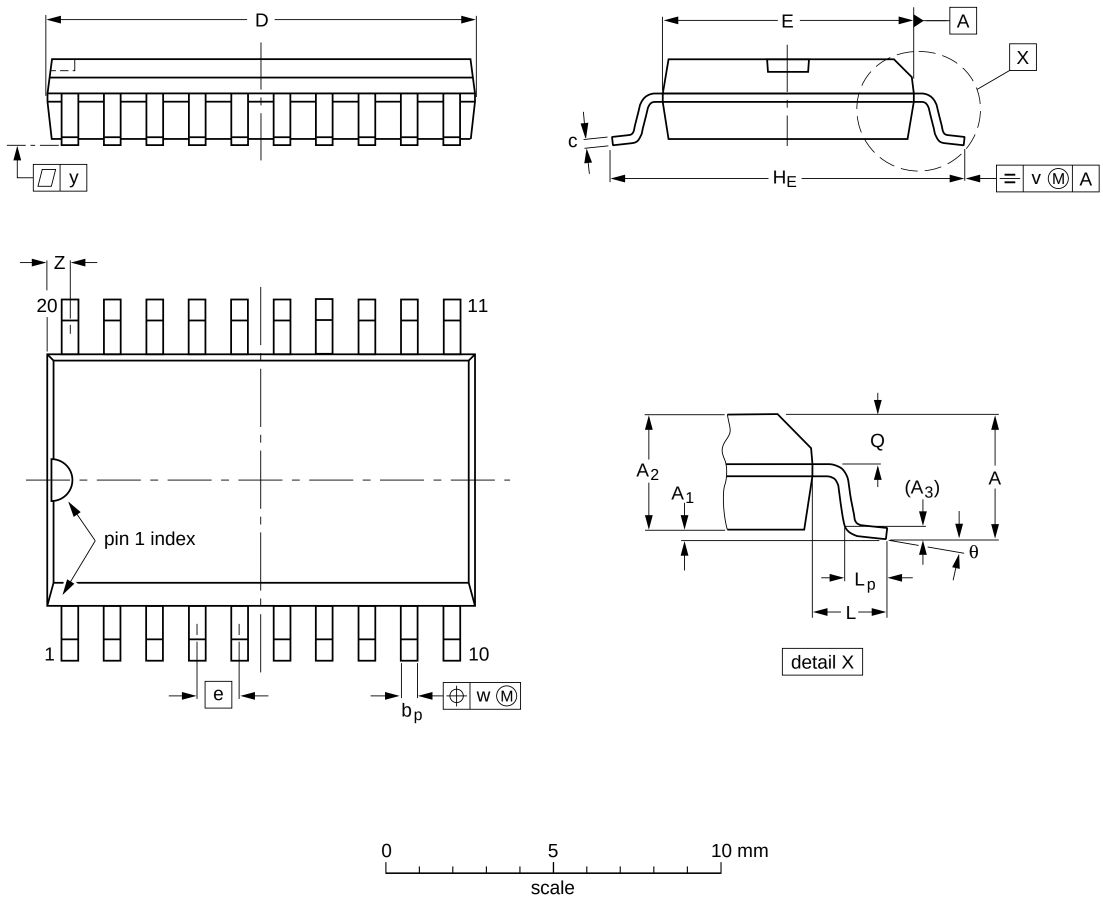
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	1.40 1.14	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	0.85
inches	0.19	0.020	0.15	0.055 0.044	0.021 0.015	0.055 0.044	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.033

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT102-1						~~93-10-14~~ 95-01-23

SO20: plastic small outline package; 20 leads; body width 7.5 mm **SOT163-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8^o 0^o
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.050	0.42 0.39	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT163-1	075E04	MS-013AC				~~92-11-17~~ 95-01-24

SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"IC Package Databook"* (order code 9398 652 90011).

DIP

SOLDERING BY DIPPING OR BY WAVE

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\ max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

REPAIRING SOLDERED JOINTS

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

SO

REFLOW SOLDERING

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

WAVE SOLDERING

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

REPAIRING SOLDERED JOINTS

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.